REMARKS

Claims 26 and 28-78 are pending in the application with new claim 78 added herein. Applicant expresses appreciation for allowance of claims 26 and 28-77.

This Request for Continued Examination (RCE) Application is being filed in an abundance of caution to permit consideration of a Supplemental Information Disclosure Statement.

No new matter is being presented in this application.

A telephonic interview is requested in the event that the next office action is one other than a Notice of Allowance. The undersigned is available during normal business hours (Pacific Time Zone).

Applicant herein amends the specification to correct errors that occurred in converting conductivity data from units of Ohm^{-1} meter^{-1} to units of microOhm^{-1} centimeter^{-1}, as used in the present specification. Applicant asserts that, pursuant to MPEP 2163.07, the amendment is not new matter since it merely corrects an obvious error. Those of ordinary skill would recognize the existence of the error as well as the appropriate correction. For example, page 12, lines 16-18 of the present specification states that semiconductive material has a conductivity of about 10^{4} to about 10^{12} microOhm^{-1} centimeter^{-1}, but those of ordinary skill readily recognize that the stated range sets forth too high of conductivity for semiconductive material.

Page 523 of "Introduction to Materials Science for Engineers," a copy of which is attached hereto, states that semiconductive material has a conductivity in the range of 10^{-4} to 10^{4} Ohm^{-1} meter^{-1} (10^{-12} to 10^{-4} microOhm^{-1} centimeter^{-1}). It is readily apparent that the incorrect range of conductivity set forth in the present specification may be

obtained by applying a conversion factor of 10^8 to the range set forth on page 523 of the reference. Also, it is apparent to those of ordinary skill that a conversion factor of 10^{-8} should instead be applied to the range set forth on page 523 of the reference to convert units of Ohm^{-1} $meter^{-1}$ to $microOhm^{-1}$ $centimeter^{-1}$. Respective amendments are made to the values described on page 12, lines 13-16. At least for such reasons, Applicant asserts that the amendments do not constitute new matter.

In addition, Applicant takes exception to certain of the Office's of Reasons for Allowance. The Office is reminded that the patent statutes require claims to be presented and interpreted in accordance with what the Applicant regards as its invention, not as to what the Office regards as the invention. Accordingly, the Office must read the claims as Applicant regards them (as they are worded), not as the Office might regard them.

Certain of the Office's statements refer to language that is not in all of the claims and, accordingly, do not follow from allowability of claims that do not literally include such language. Certain of the Office's statements might be interpreted later as reading limitations into Applicant's claims that simply are not there, or otherwise indicate that the Applicant must regard its invention as that to which the Office has interpreted outside the literal claim language.

For example, the Office states that the claims are allowable since the prior art does not disclose a conductive barrier layer to oxygen diffusion. This might be interpreted to conclude that the Office reads Applicant's claims to include this limitation and that therefore all of the claims are so limited. Yet, Applicant did not include such limitation in all of the currently pending claims, and had no intention that all of its filed

and examined claims would be so limited. Specifically, claim 43 sets forth a capacitor construction that includes, among other features, a layer of a metal-containing conductive material over a first electrode, the material including a chemisorption product of first and second precursor layers. However, claim 43 does not limit the layer of metal-containing conductive material to being a barrier layer to oxygen diffusion.

The Office must interpret the claims in accordance with their literal wording, and, to the extent that the Office has not already done so such is mandated now. If the Office relies for allowance upon language not appearing in the claims, then the Office must reject the claims and suggestion insertion of such language. Then, Applicant can respond as it deems appropriate.

Allowance of the claims as literally worded is urged. Entry of new claim 78 essentially precludes independent claim 43 from in any way being interpreted that the stated barrier layer to oxygen diffusion is required for allowability of claim 43. If the Office enters this amendment, this file history is to be interpreted as if the Office's statement on Reasons for Allowance in the Notice of Allowance never existed or was withdrawn. If the Office disagrees with this just stated position, claim rejections are mandated or modification of the statements on Reasons for Allowance is warranted.

Respectfully submitted,

Dated: 26 Jan 2004

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INTRODUCTION TO Materials Science FOR Engineers

SECOND EDITION

James F. Shackelford
University of California, Davis

Macmillan Publishing Company
New York
Collier Macmillan Publishers
London

TABLE 11.1-1 Electrical Conductivities of Some Materials at Room Temperature

Conducting Range	Material	Conductivity, σ ($\Omega^{-1} \cdot m^{-1}$)
Conductors	Aluminum (annealed)	35.36×10^6
	Copper (annealed standard)	58.00×10^6
	Iron (99.99 + %)	10.30×10^6
	Steel (wire)	$5.71–9.35 \times 10^6$
Semiconductors	Germanium (high purity)	2.0
	Silicon (high purity)	0.40×10^{-3}
	Lead Sulfide (high purity)	38.4
Insulators	Aluminum oxide	$10^{-10}–10^{-12}$
	Borosilicate glass	10^{-13}
	Polyethylene	$10^{-13}–10^{-15}$
	Nylon 66	$10^{-12}–10^{-13}$

Source: Data from C. A. Harper, ed., *Handbook of Materials and Processes for Electronics*, McGraw-Hill Book Company, New York, 1970; and J. K. Stanley, *Electrical and Magnetic Properties of Metals*, American Society for Metals, Metals Park, Ohio, 1963.

The drift velocity is in units of m/s, and the electric field strength ($E = V/\ell$) in units of V/m.

When both positive and negative charge carriers are contributing to conduction, Equation 11.1-4 must be expanded to account for both contributions:

$$\sigma = n_n q_n \mu_n + n_p q_p \mu_p \tag{11.1-6}$$

The subscripts n and p refer to the negative and positive carriers, respectively. For electrons, electron holes, and monovalent ions, the magnitude of q is 0.16×10^{-18} C. For multivalent ions, the magnitude of q is $|Z_i| \times (0.16 \times 10^{-18}\text{ C})$, where $|Z_i|$ is the magnitude of the valence (e.g., 2 for O^{2-}).

Table 11.1-1 lists values of conductivity for a wide variety of engineering materials. It is apparent that the magnitude of conductivity produces distinctive categories of materials consistent with the types outlined in Chapters 1 and 2. We shall discuss this electrical classification system in detail at the end of this chapter (Section 11.7). But first, it is necessary to look at the nature of electrical conduction in order to understand why conductivity varies by more than 20 orders of magnitude among common engineering materials.

Sample Problem 11.1-1

A wire sample (1 mm in diameter by 1 m in length) of an aluminum alloy (containing 1.2% Mn) is placed in an electrical circuit such as that shown in Figure 11.1-1. A voltage drop of 432 mV is measured across the length the wire as it carries a 10-A current. Calculate the conductivity of this alloy.

Sample Problem 11.4-2

The polarization for a ferroelectric is defined as the density of dipole moments. Calculate the polarization for tetragonal $BaTiO_3$.

Solution

Using the results of Sample Problem 11.4-1(a) and the unit cell geometry of Figure 11.4-3, we obtain

$$P = \frac{\Sigma\, Qd}{V}$$

$$= \frac{10.56 \times 10^{-30}\ \mathrm{C \cdot m}}{(0.403 \times 10^{-9}\ \mathrm{m})(0.399 \times 10^{-9}\ \mathrm{m})^2}$$

$$= 0.165\ \mathrm{C/m^2}$$

11.5 Semiconductors

The magnitudes of conductivity in the semiconductors in Table 11.1-1 fall within the range 10^{-4} to $10^{+4}\ \Omega^{-1} \cdot \mathrm{m}^{-1}$. This intermediate range corresponds to band gaps of less than 2 eV. As shown in Figure 11.2-8, both conduction electrons and electron holes are charge carriers in a simple semiconductor. For the example of Figure 11.2-8 (pure silicon), the number of conduction electrons is equal to the number of electron holes. Pure, elemental semiconductors of this type are called *intrinsic semiconductors*. This is the only case we shall deal with in this chapter. In Chapter 12, the important role of impurities in semiconductor technology will be demonstrated in our discussion of *extrinsic semiconductors*, semiconductors with carefully controlled, small amounts of impurities. For now, we can transform the general conductivity expression (Equation 11.1-6) into a specific form for intrinsic semiconductors:

$$\sigma = nq(\mu_e + \mu_h) \tag{11.5-1}$$

where n is the density of conduction electrons (= density of electron holes), q the magnitude of electron charge (= magnitude of hole charge = 0.16×10^{-18} C), μ_e the mobility of a conduction electron, and μ_h the mobility of an electron hole. Table 11.5-1 gives some representative values of μ_e and μ_h together with E_g, the energy band gap and the carrier density at room temperature. Inspection of the mobility data indicates that μ_e is consistently higher than μ_h, sometimes dramatically so. The conduction of electron holes in the valence band is a relative concept. In fact, electron holes exist only in relation to the valence electrons; that is, an electron hole is a missing valence electron. The movement of an electron hole in a given direction is simply a representation that valence electrons have moved in the opposite direction (Figure 11.5-1). The cooperative motion of the valence electrons (represented by μ_h) is an inherently slower process than the motion of the conduction electron (represented by μ_e).